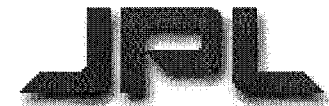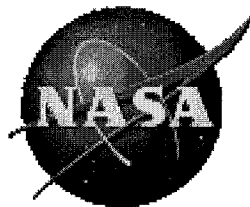# Knowledge Management at the Jet Propulsion Laboratory and NASA

Jeanne Holm

Jet Propulsion Laboratory, California Institute of Technology

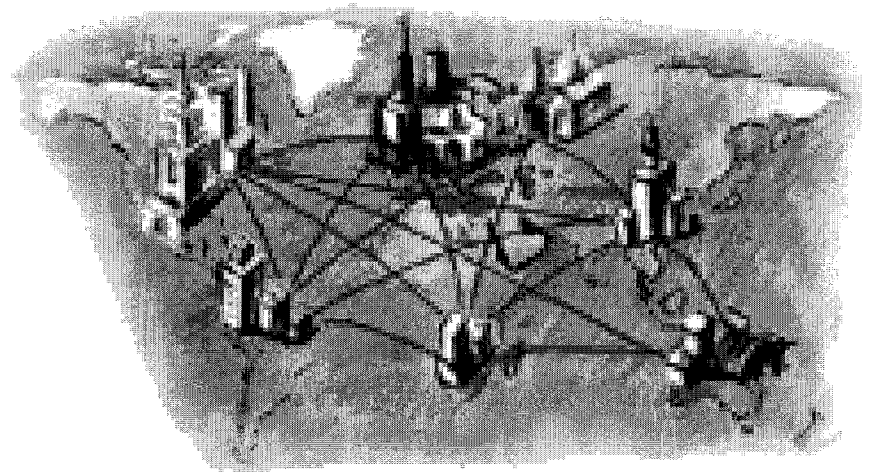Research Institutes Publishing Executives

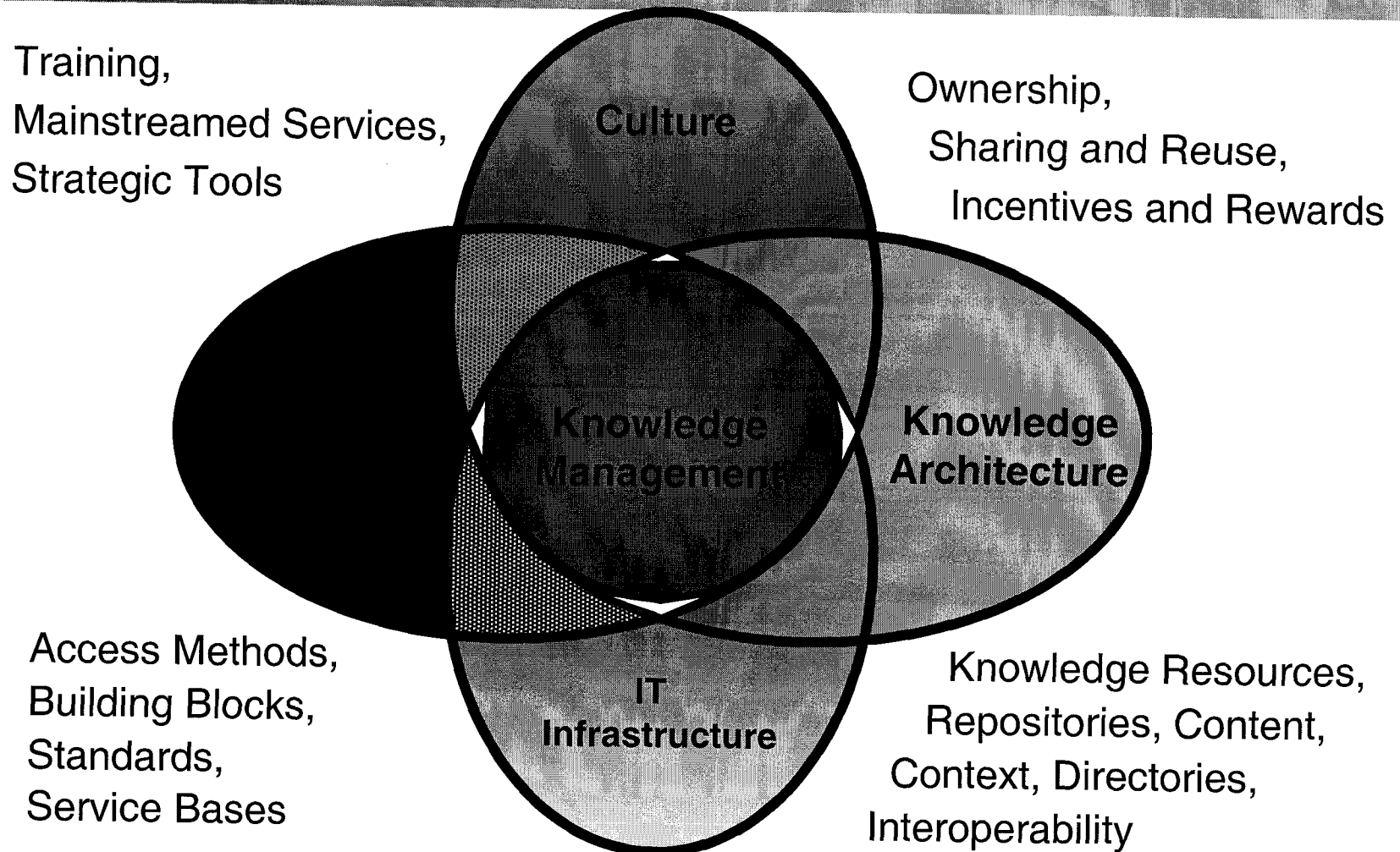October 18, 2000

Why is KM Critical to NASA?

- We are constantly challenged to document and integrate our lessons learned to effectively manage the risk involved in exploration

- By its nature, NASA employees have specialized, compartmentalized knowledge

- The workforce in the Agency is aging

- *Our goal is to share knowledge with each other and with the public*

What is Knowledge Management?

- Knowledge management is getting the right information to the right people at the right time, and helping people create knowledge and share and *act upon information* in ways that will measurably improve the performance of NASA and its partners

KM Success Factors
Learned from Benchmarking

Training,
Mainstreamed Services,
Strategic Tools

Ownership,
Sharing and Reuse,
Incentives and Rewards

Culture

Knowledge Management

Knowledge Architecture

IT Infrastructure

Access Methods,
Building Blocks,
Standards,
Service Bases

Knowledge Resources,
Repositories, Content,
Context, Directories,
Interoperability

Recognizing the Importance of Culture

- The most critical factor in the success of a KM implementation is cultural acceptance
  - Recognizing issues of data ownership: individual vs. organization
  - Acknowledging the appropriateness and acceptance of knowledge sharing and reuse
  - Rewarding individuals and teams for promoting KM
    - Capturing team discussions and decisions
    - Creating a supportive environment for mentoring
    - Documenting lessons learned
    - Making tacit knowledge explicit

KM Architectural Cornerstones

- Realize success requires cultural acceptance
- Provide access to knowledge
- Ensure knowledge is secure and validated
- Standardize only what's necessary
- Build complete service base and capabilities that are *operational* and can support mission-critical data
    - Interoperability
    - Migration tools
   - Application support and refreshment
    - Training

Est. 1998

KM Services at JPL

- Navigation
  - Use of portals, taxonomies, and enhanced search capability
- Document Management
  - Viewing the "lust to dust" lifecycle, including tools, templates, and guidelines
- Expert Connections
  - Profiles and access to technical experts
- Collaborative Environments
  - Facilitating the work of virtual teams
- Standards
  - Metadata, name spaces, and concurrent engineering standards
- Knowledge Creation
  - Creating, capturing, and sharing knowledge amongst teams
- Content Management
  - Accuracy, timeliness, and re-purposing of electronic information
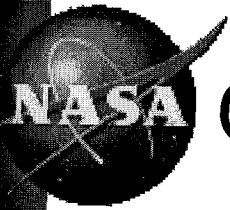
Creating an Architecture for NASA

- NASA's KM activities are led by the CIO, guided by the NASA KM Team (with anthropologists to architects)
  - Knowledge Navigation
  - Lessons Learned Information System
  - Experts Directory Service
  - – NASA KM Team developing strategic plan (December 2000)
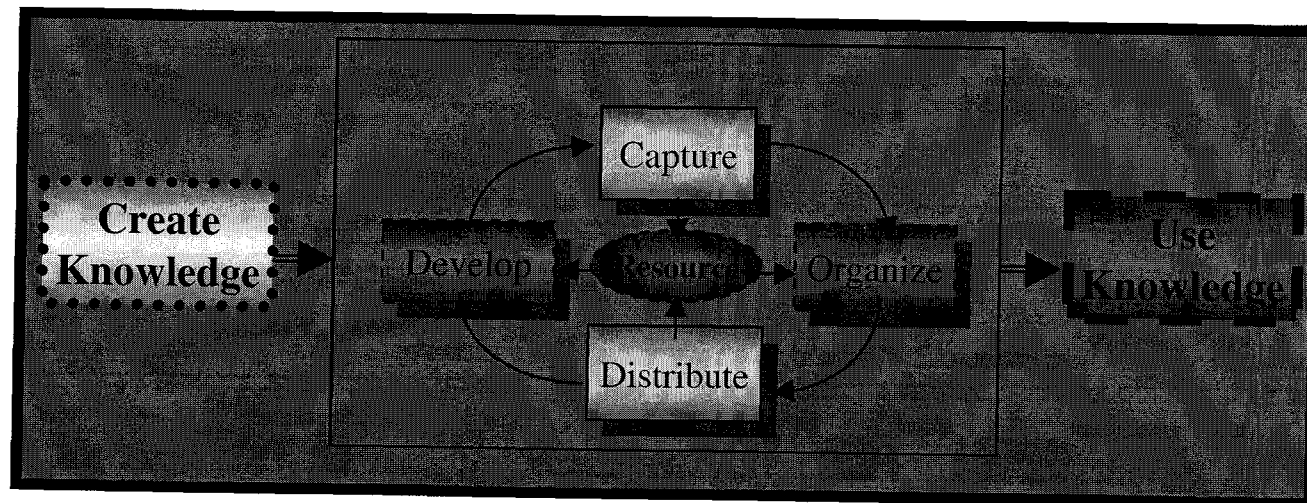
Navigating Across NASA

- Knowledge Navigation (Jet Propulsion Laboratory)
  - Allow customized views into NASA resources
  - Facilitate and broadcast communities of practice
  - Consolidate current, multiple publishing venues
  - Improve ability to share knowledge across NASA Centers and workgroups
  - Stimulate development of interoperable standards, architectures, and knowledge transfer processes between Centers to take NASA into the next generation of web usage
  - Integrating products for the user interface from iPlanet (Sun, Netscape, AOL) and agents and communities from Autonomy
  - Coordinating progress and lessons with the Federal KM Team

JPL Portal in Development

http://eis.jpl.nasa.gov/knowledge/portal/insidejpl

NASA Portal in Development

http://eis.jpl.nasa.gov/knowledge/portal/insidenasa

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inside JPL
a portal to the JPL intranet
beta version

Management | Science | Engineering | Business | Help   Search the JPL Web

Add a Channel   Set Preferences

[   ] [Find It!]

The Daily Planet for July 26, 2000

Video Window:

Video Tour of Zvezda Module

Today's Headline:
Cape Canaveral's First Rocket Launch Fires Up Celebration

News at JPL:
Office of the Director
Zvedza Docking on NASA TV
This Week
July 24-28th
Universe
July 21st Edition

Today@NASA:
Zvezda and Space Station Set To Dock

Announcements
August Blood Drive
Service Module Docking on NASA TV
Meet the Ombudsperson 7/27
Technical Library Orientation

Calendars:
JPL Events Calendar
JPL Seminar Calendar
JPL Space Calendar
NASA Upcoming Mission Launches
NASA Education Calendar

Quick Links

Phone Book
Yellow Pages
Blue Pages
JPL Maps
Labwide Help
Timecard Log In
New to JPL
Cafeteria Menus

Top Four Sites
Mars Program
DMIE
Travel
Launch Utilizations

My Data Channels

Division 32
September Travel Forecasts
Upcoming Conferences for Fall 2000
New FY 2001 Announcements of Opportunity
Center for In Situ Exploration and Sample Return - CISSR
Speaker Series: Progress Report on Mars Work
Section Meeting Notes from July 22nd
Section 333 - Ground Communications
Report from 70m X-Band Uplink Team
New Electronics for Inflatable Antennas
AIRS Project
Team Report from Imaging Node
Quarterly Telecon Schedule
JPL Office Professionals
New Timekeeping Processes
NBS Upgrades Improve Personnel Tracking
PERFORM Redesign Complete
Interferometry Center of Excellence
New Optic Technology Available Soon
SIM Project
Project Manager Due to Give PDR

Headline News

Electronic Journals:
Aviation Week
Concorde Probe Begins
Science
Diversity in Science
Nature
Unnaturally Shorn Killers

Online News Headlines:
AP Space Headlines
Orbiting output linkup hailed
Space.Com
Zvezda Docking Complete

Local Weather   Today
Areas of low clouds and locally dense fog through mid-morning. Otherwise sunny.   H 101/ L 68

Live! Traffic in L.A. County

My Bookmarks

ISO Notebook
Timecard Log In
Lockheed
Boeing
NASA Home Page
Lessons Learned System
Experts Directory

My Communities
Engineering
Standards
Technology

Directory to JPL Web Space

Directory to JPL Web Space:

Engineering and Technology
Process, Products, Resources...

Missions and Projects
Funding, Mission Directory, Research...

Publications and Information Resources
Journals, Indexes, Image Services...

Me and JPL
Benefits, Education, Travel...

Science and Research
Space Sciences, Earth Sciences, Physics...

Infrastructure Services
Computers, Safety, Security...

Getting Around JPL
Directories, Ethics, IBS...

Buy It, Ship It, Track It
Acquisition, Property, Shipping and Receiving...

Budget and Financial
Contract Management, UCS, PCAT...

Personal Searches

"robotics"
Robotics Internet Resouces Page
The Robotics Institute

"nanotechnology"
Nanotechnology on about.com
Nanotechnology Magazine
Nanotechnology Industries

"radio transmitters"
Simple Radio Transmitters
Handilinks Radio Transmitters Directory

Send Feedback to the InsideJPL Webmaster

Capturing Lessons Learned
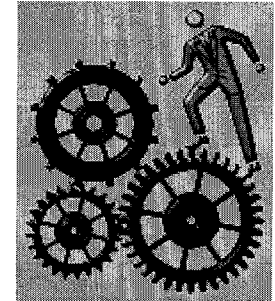
- **Lessons Learned Information System (Langley Research Center)**
  - Create and maintain a knowledge resource to facilitate archival, access, and incorporation of NASA safety and engineering experiences
    - Focuses on improving ease of capture and re-use, extending data types
    - Integrating information from lessons into risk management tools, processes, procedures, and standards
  - Increase the "design for safety" by building into our processes the lessons learned by others and mitigate risk through better integration of Agency knowledge
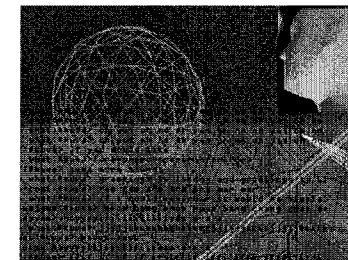
Locating Experts at NASA

Experts Directory Service (Goddard Space Flight Center)

- Quickly find science and engineering experts across the Agency for NASA personnel trying to locate others working in a related field or on a particular project to facilitate collaboration among distributed groups

  - Working with Florida International University and University of Maryland, Baltimore County to prototype profiling, agent technology, and searching
  - Established connectivity to Human Resources and other "experts-related" databases
  - Using Autonomy software product suite
  - Completing three separate concept-of-design prototype applications

KM Partnerships

- Lots of people are already doing KM, our job is to find *good* solutions and build a federation of resources for our employees and partners

- KM supports other processes and initiatives, building infrastructure, applications, and "filling the gaps" for processes, tools, and methods

- KM activities are also working at the Federal level
  - Active on the Federal Knowledge Management Team
    - Bridging Government, industry, and academia
    - Sharing best practices and methods
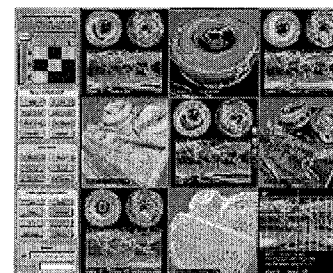   - Bringing KM to the forefront in policies, laws, and to Congress
    - http://km.gov

Knowledge Management Roadmap

Sharing Knowledge
- Adaptive knowledge infrastructure is in place
- Knowledge resources identified and shared appropriately
- Timely knowledge gets to the right person to make decisions
- Intelligent tools for authoring through archiving
- Cohesive knowledge development between NASA, its partners, and customers

Enables sharing of essential knowledge to complete Agency tasks

↳
- MarsNet
- Europa Orbiter
- SIM

Integrating Distributed Knowledge
- Instrument design is semi-automatic based on knowledge repositories
- Mission software auto-instantiates based on unique mission parameters
- KM prinicipals are part of NASA culture and supported by layered COTS products
- Remote data management allows spacecraft to self-command

Enables seamless integration of systems throughout the world and with robotic spacecraft

↳
- Europa Lander/Submersible
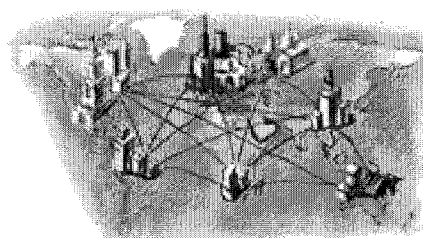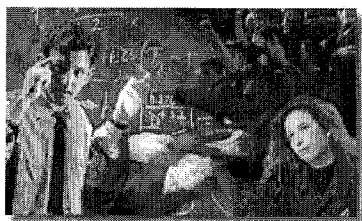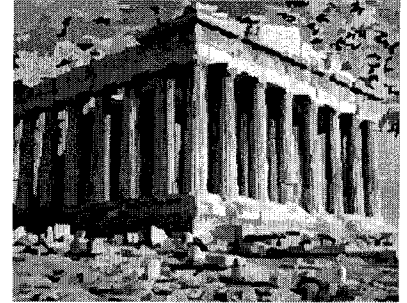- Titan Organics: Lander/Aerobot
- Neptune Orbiter/Triton Observer

Capturing Knowledge
- Knowledge gathered anyplace from hand-held devices using standard formats on interplanetary Internet
- Expert systems on spacecraft analyze and upload data
- Autonomous agents operate across existing sensor and telemetry products
- Industry and academia supply spacecraft parts based on collaborative designs derived from NASA's knowledge system

Enables capture of knowledge at the point of origin, human or robotic, without invasive technology

↳
- Mars robotic outposts
- Comet Nucleus Sample Return
- Saturn Ring Observer

Modeling Expert Knowledge
- Systems model experts' patterns and behaviors to gather knowledge implicitly
- Seamless knowledge exchange with robotic explorers
- Planetary explorers contribute to their successor's design from experience and synthesis
- Knowledge systems collaborate with experts for new research

Enables real-time capture of tacit knowledge from experts on Earth and in permanent outposts

↳
- Interstellar missions
- Permanent colonies

| **2003** | **2007** | **2010** | **2025** |

Lessons Learned in Our Journey

- Get executive sponsorship
- Find others doing or supporting "knowledge management" (providers or infrastructure)
  - Build a federated team with diverse talents
  - Analyze your current resources and infrastructure
- Gather requirements
  - Understand your customers, constraints, potential service providers, and *the culture*
- Design a long-term, sustainable solution
  - Provide rigorous system engineering

Lessons Learned (continued)

- Find *more* partners and pilots
- Develop solutions, services, and rewards
  - Deliver specific solutions to specific customers
  - Make the services fully operational (including funding and metrics)
  - Reward knowledge sharers
  - Recognize contributions of the KM team and others